

MEMORANDUM OF UNDERSTANDING

BETWEEN THE

**NATIONAL AERONAUTICS
AND SPACE ADMINISTRATION
OF THE UNITED STATES OF AMERICA**

AND THE

EUROPEAN SPACE AGENCY

**CONCERNING THE
LASER INTERFEROMETER SPACE ANTENNA (LISA) PATHFINDER MISSION**

The National Aeronautics and Space Administration of the United States of America (hereinafter referred to as "NASA"),

and

The European Space Agency, an international intergovernmental organisation established by the Convention which was opened for signature in Paris on 30 May 1975 and entered into force on October 30, 1980 (hereinafter referred to as "ESA"),

Hereinafter jointly referred to as "the Parties,"

PREAMBLE

RECALLING that the Parties have a mutual interest in cooperation on the Laser Interferometer Space Antenna mission (hereinafter referred to as "the LISA Mission") aiming at increasing the scientific knowledge of gravitational waves and the fundamental insights they may shed on key questions of modern physics, including the mechanism that powered the Big Bang, the conditions of space, time, and matter at the edge of a black hole, and the nature of "dark energy";

NOTING that to establish the performance requirements needed for the LISA Mission and to prove the required technologies, ESA has initiated, in the frame of its Cosmic Vision programme, a demonstration mission called the Laser Interferometer Space Antenna Pathfinder mission (hereinafter referred to as "the LISA Pathfinder Mission"), the second of its Small Missions for Advanced Research and Technology (formerly referred to as "SMART-2"),

RECALLING that ESA will provide the LISA Technology Package (hereinafter referred to as "the LTP"), developed by the European scientific and industrial community using national and ESA funds,

RECALLING also that NASA, as part of its New Millennium Programme (hereinafter referred to as "the NMP"), has selected the Disturbance Reduction System package (hereinafter referred to as "the DRS") and has held fruitful discussions with ESA regarding its integration into the LISA Pathfinder mission,

CONSIDERING the successful results of the interim study-phase agreement, which addressed preliminary activities of the Parties and their potential cooperation on LISA and its associated technology demonstration mission, LISA Pathfinder,

HAVE AGREED as follows:

ARTICLE 1 - PURPOSE AND OBJECTIVES

1. The purpose of this Memorandum of Understanding (hereinafter referred to as "MOU") is to define the terms and conditions under which the cooperation between the Parties shall be conducted within the framework of the LISA Pathfinder mission.
2. This MOU is designed to facilitate cooperation between the Parties with respect to the LISA Pathfinder mission. It describes managerial, technical, and operational interfaces between the Parties that are necessary to ensure continuation of and compatibility between their respective activities, the roles and responsibilities of the Parties, and the other commitments of the Parties.
3. On the basis of the experience resulting from implementation of the LISA Pathfinder Mission, the Parties will consider, at an appropriate time, the opportunity to develop a second MOU dedicated to the LISA Mission.

ARTICLE 2 - DEFINITIONS

For the purpose of this MOU:

(a) The term "Related Entity" means:

- (i) a contractor, subcontractor, or sponsored entity of a Party at any tier;
- (ii) a user or customer of a Party at any tier;
- (iii) a contractor or subcontractor of a user or customer or sponsored entity of a Party at any tier; or
- (iv) a scientific investigator.

The terms "contractor" and "subcontractor" include suppliers of any kind.

For the purpose of Article 14 (Liability), the term "Related Entity" may also include another State or an agency or institution of another State, where such State, agency, or institution is an entity as described in (i) through (iv) above or is otherwise involved in the activities undertaken pursuant to this MOU.

(b) The term "damage" means:

- (i) bodily injury to, or other impairment of health of, or death of, any person;
- (ii) damage to, loss of, or loss of use of any property;
- (iii) loss of revenue or profits; or
- (iv) other direct, indirect, or consequential damage.

(c) The term "launch vehicle" means an object or any part thereof intended for launch.

(d) The term "payload" means all property to be flown or used on or in a launch vehicle;

(e) The term "Protected Space Operations" means all activities pursuant to this MOU, including launch vehicle activities and payload activities on Earth, in outer space, or in transit between Earth and outer space. "Protected Space Operations" begin at the entry into force of this MOU and end when all activities done in implementation of this MOU are completed. It includes, but is not limited to:

- (i) research, design, development, test, manufacture, assembly, integration, operation, or use of launch or transfer vehicles, payloads, or instruments, as well as related support equipment and facilities and services;
- (ii) all activities related to ground support, test, training, simulation, or guidance and control equipment and related facilities or services.

The term "Protected Space Operations" excludes activities on Earth that are conducted on return from space to develop further a payload's product or process for use other than for the LISA Pathfinder mission.

ARTICLE 3 - LISA PATHFINDER MISSION DESCRIPTION

1. The LISA Pathfinder mission is an ESA technology precursor mission to the planned LISA Mission. The LISA Pathfinder Mission aims at validating the performance of technologies for precision spacecraft control, flying two test packages, the LTP and the DRS.
2. The LTP is designed to comprise two gravitational sensors, an optical bench and related optical metrology system that, in conjunction with a micropropulsion system and associated drag-free control software, will attempt to validate the drag-free flight concept. The LTP sensors are intended to be used to monitor the position of the spacecraft with respect to a freely floating test mass.
3. The DRS is designed to include micropropulsion thrusters, supporting electronics and housekeeping avionics, and data handling and drag-free attitude control software. It is planned that the sensors used by the DRS shall be the European LTP. It is also planned that the DRS thrusters shall be used to adjust the position of the spacecraft to keep it centred on the test mass. The spacecraft position control performance is expected to be evaluated by assessing the LTP metrology data.

4. The inclusion of both the DRS and the LTP on the LISA Pathfinder Mission shall make possible a comparative assessment of the performance of the two types of actuators and control algorithms, as well as an assessment of their individual performance.

ARTICLE 4 – ESA PROGRAMMATIC RESPONSIBILITIES

ESA shall use reasonable efforts to:

- (a) design, develop, build, test, integrate, launch, and control the LISA Pathfinder spacecraft, including integration of the DRS flight hardware, based on a DRS nominal delivery time frame of August 2007;
- (b) operate the DRS experiment after launch as part of the LISA Pathfinder mission, including forwarding commands for the DRS package, collecting telemetry, and forwarding it to ground.
- (c) make available DRS technology data products to NASA in accordance with Article 9 (Rights in and Distribution of Data); and
- (d) exchange LTP sensor data and test configuration data from both ground tests and flight validation experiments.

ARTICLE 5 – NASA PROGRAMMATIC RESPONSIBILITIES

NASA shall use reasonable efforts to:

- (a) design, develop, build, and test the DRS and deliver it to ESA according to the nominal delivery timeframe of August 2007;
- (b) support the integration and test of the DRS onto the LISA Pathfinder spacecraft;
- (c) cooperate in ESA's LISA Pathfinder mission operations planning and training, in accordance with the ST7-DRS/SMART-2 Implementation Agreement Document (hereinafter referred to as the "IAD") as defined in Article 6.2 (Management and Documentation), including provision of DRS-related telecommand and telemetry databases, flight procedures input, and DRS Flight User Manual;
- (d) reduce and analyse the DRS technology data, as appropriate; and

- (e) exchange DRS drag-free attitude control system and thruster performance data and test configuration data from both ground tests and flight validation experiments, including measurements to quantify possible contamination from thrusters.

ARTICLE 6 - MANAGEMENT AND DOCUMENTATION

1. ESA and NASA cooperation in the LISA Pathfinder Mission shall be managed through a joint effort by the Parties' respective Project Managers.
2. Management details for the activities described in this MOU shall be defined in the IAD. The IAD shall be jointly developed, agreed upon, and revised as necessary by the ESA and NASA Project Managers and shall be subject to this MOU. The IAD shall define the detailed implementing arrangements for the undertakings given in this MOU. The IAD may address such items as management and procedural requirements, a list of required documentation, programme implementation schedule, technical reviews, applicable standards, verification, and acceptance. The Parties shall provide complete and timely documentation in accordance with the requirements specified in the IAD.

ARTICLE 7 - REVIEWS

NASA and ESA shall be invited to participate in each other's reviews as appropriate. In particular:

- (a) NASA shall be invited to participate in those ESA reviews that involve or have a significant impact on NASA's contributions and shall be invited to the Flight Acceptance and Flight Readiness Reviews; and
- (b) ESA shall be invited to participate in those NASA progress meetings and reviews of the DRS having significant relevance to confirm the DRS status, design, integration, and verification as a payload of the LISA Pathfinder Mission.
- (c) Reviews shall be conducted according to agreed upon ESA/NASA procedures and in compliance with the LISA Pathfinder Mission schedule.

ARTICLE 8 - TRANSFER OF GOODS AND TECHNICAL DATA

1. The Parties are obligated to transfer only those goods and technical data (including software) necessary to fulfill their respective responsibilities under this MOU, in accordance with the following provisions:
 - (a) All activities of the Parties shall be carried out in accordance with applicable laws, rules, and regulations, including those pertaining to export control and the control of classified information.
 - (b) The transfer of goods and technical data for the purpose of discharging the Parties' responsibilities with regard to interface, integration, and safety shall be made without restriction, except as provided in paragraph (a) above.
 - (c) All transfers of goods and proprietary or export-controlled technical data are subject to the following provisions. In the event a Party or its Related Entity finds it necessary to transfer goods or to transfer proprietary or export-controlled technical data, for which protection is to be maintained, such goods shall be specifically identified and such proprietary or export-controlled technical data shall be marked. The identification for goods and the marking on proprietary or export-controlled technical data will indicate that the goods and proprietary or export-controlled technical data shall be used by the receiving Party or its Related Entities only for the purposes of fulfilling the receiving Party's or Related Entity's responsibilities under this MOU, and that the identified goods and marked proprietary technical data or marked export-controlled technical data shall not be disclosed or retransferred to any other entity without the prior written permission of the furnishing Party or its Related Entity. The receiving Party or its Related Entity shall abide by the terms of the notice and protect any such identified goods and marked proprietary technical data or marked export-controlled technical data from unauthorized use and disclosure. The Parties to this MOU will cause their Related Entities to be bound by the provisions of this Article related to use, disclosure, and retransfer of identified goods and marked technical data through contractual mechanisms or equivalent measures.
2. All goods and marked proprietary or export-controlled technical data exchanged in the performance of this MOU shall be used by the receiving Party or its Related Entity exclusively for the purposes of the MOU. Upon completion of the activities under this MOU, the receiving Party or its Related Entity shall return or, at the request of the furnishing Party or its Related Entity, otherwise dispose of all goods and marked proprietary or export-controlled technical data provided under this MOU, as directed by the furnishing Party or its Related Entity.

ARTICLE 9 - RIGHTS IN AND DISTRIBUTION OF DATA

1. During joint operations of DRS with LTP, the Parties and all LISA Pathfinder Mission investigators (hereinafter referred to as "Mission Investigators") shall have access to all data resulting from the LISA Pathfinder Mission upon it becoming available.
2. Mission Investigators shall have an exclusive first-publication right. The duration of the exclusive right shall be three (3) months (hereinafter referred to as the "Restricted Period") from receipt by the Mission Investigators of the LISA Pathfinder data in a form suitable for analysis. Mission Investigators shall share data between them to enhance the scientific return from the Mission. Following the Restricted Period, the LISA Pathfinder data records, or copies of processed data, shall be deposited with the ESA-designated facility and the U.S. National Space Science Data Center (NSSDC).
3. The Parties shall have the right to use the data (processed and unprocessed) at any time, in support of their respective responsibilities, without prejudice to the Mission Investigators' first-publication rights.

ARTICLE 10- INTELLECTUAL PROPERTY

1. Nothing in this MOU shall be construed as granting, either expressly or by implication, to the other Party any rights to, or interest in, any inventions or works of a Party or its Related Entities made prior to the entry into force of, or outside the scope of, this MOU, including any patents (or similar forms of protection in any country) corresponding to such inventions or any copyrights corresponding to such works.
2. Any rights to, or interest in, any invention or work made in the performance of this MOU solely by one Party or any of its Related Entities, including any patents (or similar forms of protection in any country) corresponding to such invention or any copyright corresponding to such works, shall be owned by such Party or its Related Entity. Allocation of rights to, or interest in, such invention or work between such Party and its Related Entities shall be determined by applicable laws, rules, regulations, and contractual obligations.
3. It is not anticipated that there will be any joint inventions made in the performance of this MOU. Nevertheless, in the event that an invention is jointly made by the Parties in the performance of this MOU, the Parties shall, in good faith, consult and agree within 30 calendar days as to:

- (a) the allocation of rights to, or interest in, such joint invention, including any patents (or similar forms of protection in any country) corresponding to such joint invention;
 - (b) the responsibilities, costs, and actions to be taken to establish and maintain patents (or similar forms of protection in any country) for each such joint invention; and
 - (c) the terms and conditions of any license or other rights to be exchanged between the Parties or granted by one Party to the other Party.
4. For any work jointly authored by the Parties, should the Parties decide to register the copyright in such work, they shall in good faith, consult and agree as to the responsibilities, costs, and actions to be taken to register copyrights and maintain copyright protection (in any country).
5. Subject to the provisions of Article 8 (Transfer of Goods and Technical Data) and Article 11 (Release of Results and Public Information), each Party shall have an irrevocable royalty-free right to reproduce, prepare derivative works, distribute, and present publicly, and authorise others to do so on its behalf, any copyrighted work resulting from activities undertaken in the performance of this MOU for its own purposes, regardless of whether the work was created solely by, or on behalf of, the other Party or jointly with the other Party.

ARTICLE 11 – RELEASE OF RESULTS AND PUBLIC INFORMATION

1. The Parties retain the right to release public information regarding their own activities under this MOU. The Parties shall coordinate with each other in advance concerning releasing to the public information that relates to the other Party's responsibilities or performance under this MOU.
2. The Parties shall make the final results obtained from the LISA Pathfinder mission available to the general scientific community through publication in appropriate journals or by presentations at scientific conferences as soon as possible and in a manner consistent with good scientific practices.
3. In all publications concerning the LISA Pathfinder mission and its results, the Parties will endeavour to acknowledge that the LISA Pathfinder is an ESA mission with instruments funded by the Agenzia Spaziale Italiana (ASI), the Centre National d'Etudes Spatiales (CNES), the Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), the Ministerio de Educación y Ciencia (MEC-PNE), the Science and Technology Facilities Research Council (STFC), the Space Research Organisation of the Netherlands (SRON), Switzerland and NASA.

4. The Parties acknowledge that the following data or information does not constitute public information and that such data or information shall not be included in any publication or presentation by a Party under this Article without the other Party's prior written permission:

- (a) data furnished by the other Party in accordance with Article 8 (Transfer of Goods and Technical Data) of this MOU which is export-controlled, classified or proprietary; or
- (b) information about an invention of the other Party before an application for a patent (or similar form of protection in any country) corresponding to such invention, has been filed covering the same, or a decision not to file has been made.

ARTICLE 12 - FINANCIAL ARRANGEMENTS

- 1. Each Party shall bear the costs of discharging its respective responsibilities under this MOU, including travel and subsistence of its own personnel and transportation of goods and associated documentation, for which it is responsible.
- 2. The Parties' obligations hereunder are subject to their respective funding procedures and the availability of appropriated funds. Should either Party encounter budgetary problems in the course of its respective internal procedures that may affect the activities carried out under this MOU, that Party shall notify and consult with the other Party in a timely manner in order to minimise the negative impact of such problems on the cooperation.

ARTICLE 13 - CUSTOMS CLEARANCE AND OWNERSHIP

- 1. In accordance with the laws and regulations governing the Parties, each Party shall facilitate free customs clearance and waiver of all applicable customs duties and taxes for goods necessary for the implementation of this MOU. In the event that any customs duties or taxes of any kind are nonetheless levied on such goods, such customs duties or taxes shall be borne by the Party related to the authority levying such customs duties or taxes. The Parties' obligation to ensure duty-free entry and exit of goods is fully reciprocal.
- 2. Each Party shall retain ownership of all the goods, hardware, and software, including associated technical data and any Ground Support Equipment (GSE), it provides to the other Party under the terms of this MOU, without prejudice to any individual rights of ownership of the Parties' respective Related Entities.

ARTICLE 14 - LIABILITY

1. The Parties agree that a comprehensive cross-waiver of liability between the Parties and their Related Entities shall further participation in space exploration, use, and investment. The cross-waiver of liability shall be broadly construed to achieve this objective. The terms of the waiver are set out below.
2. (a) Each Party agrees to a cross-waiver of liability pursuant to which each Party waives all claims against the other Party, the other Party's Related Entities, employees of the other Party, and employees of the other Party's related Entities, based on damage arising out of Protected Space Operations. This cross-waiver shall apply only if the person, entity, or property causing the damage is involved in Protected Space Operations and the person, entity, or property damaged is damaged by virtue of its involvement in Protected Space Operations. The cross-waiver shall apply to any claims for damage, whatever the legal basis for such claims, except in the case of wilful misconduct.

(b) Each Party shall extend the cross-waiver of liability to its own Related Entities by requiring them, by contract or otherwise, to agree to waive all claims against the other Party, the other Party's Related Entities, and employees of the other Party or its Related Entities, based on damage arising out of Protected Space Operations.

(c) For avoidance of doubt, this cross-waiver of liability includes a cross-waiver for any liability arising from the Convention on International Liability for Damage Caused by Space Objects, which entered into force on 1 September 1972 (hereinafter referred to as the "Liability Convention"), where the person, entity, or property causing the damage is involved in Protected Space Operations and the person, entity, or property damaged is damaged by virtue of its involvement in Protected Space Operations.

(d) Notwithstanding the other provisions of this section, this cross-waiver of liability shall not be applicable to:
 - (i) claims between a Party and its own Related Entity or among its own Related Entities;
 - (ii) claims made by a natural person, his/her estate, survivors, or subrogees (except when a subrogee is a Party to this MOU or is otherwise bound by the terms of this cross-waiver) for bodily injury, other impairment of health, or death of such natural person; or
 - (iii) intellectual property claims.

(e) This cross-waiver of liability shall not apply to performance of the Parties' obligations under this MOU.

(f) Nothing in this Article shall be construed to create the basis for a claim or suit where none would otherwise exist.

(g) In the event of third-party claims which may arise out of, *inter alia*, the Liability Convention, the Parties shall consult promptly on any potential liability, on any apportionment of such liability, and on the defence of such claim.

ARTICLE 15 - REGISTRATION - JURISDICTION AND CONTROL

ESA shall register the LISA Pathfinder spacecraft in accordance with the Convention on Registration of Objects Launched into Outer Space, which entered into force on 15 September 1976. ESA shall retain jurisdiction and control over the space objects that it registers.

ARTICLE 16 - MISHAP INVESTIGATION

In the case of a mishap or mission failure, the Parties shall provide assistance to each other in the conduct of any investigation, bearing in mind, in particular, the provisions of Article 8. In the case of activities that might result in the death of, or serious injury to persons, or substantial loss of, or damage to property as a result of activities under this MOU, the Parties shall establish a process for investigating each such mishap as part of their program/project-level implementation plans.

ARTICLE 17 - AMENDMENT

This MOU may be amended by written agreement of the Parties.

ARTICLE 18 - CONSULTATION AND SETTLEMENT OF DISPUTES

The Parties shall consult with each other promptly when events occur or matters arise, which may question the interpretation or implementation of the terms of this MOU. Any dispute in the interpretation or implementation of the terms of this MOU shall be first referred to the ESA LISA Pathfinder Project Manager and the NASA LISA Pathfinder Program Executive. If necessary, the dispute shall then be referred to the ESA Director of

Science and the NASA Associate Administrator for the Science Mission Directorate, or their designees. Any dispute which cannot be resolved at this level shall be referred to the Director General of ESA and the Administrator of NASA, or their designees. Failing agreement at that level, the Parties may agree to submit the dispute to an agreed form of dispute resolution.

ARTICLE 19 - ENTRY INTO FORCE, DURATION, AND TERMINATION

1. This MOU shall enter into force upon signature by the Parties. It shall remain in force until June 30, 2011, unless extended by written agreement of the Parties, or terminated in accordance with Article 19.2.
2. Either Party may terminate this MOU at any time by giving the other Party at least 6 months written notice of its intent to terminate. Termination of this MOU shall not affect a Party's continuing obligations under Article 8 (Transfer of Goods and Technical Data), Article 9 (Rights in and Distribution of Data), Article 10 (Intellectual Property), Article 11 (Release of Results and Public Information), Article 12 (Financial Arrangements), Article 13 (Customs Clearance and Ownership), Article 14 (Liability), Article 15 (Registration, Jurisdiction and Control), Article 16 (Mishap Investigation) and Article 18 (Consultation and Settlement of Disputes), unless otherwise agreed by the Parties. In the event of termination, the Parties shall endeavour to minimise any negative impact of such termination on the other Party.

IN WITNESS WHEREOF, the Parties have caused their duly authorised representatives to sign two originals of this MOU, in the English language.

Done at Paris, this 18th day of June 2007

National Aeronautics and Space
Administration of the United States of America

For the European Space Agency


MICHAEL D. GRIFFIN
ADMINISTRATOR


JEAN-JACQUES DORDAIN
DIRECTOR GENERAL

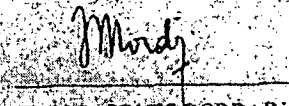
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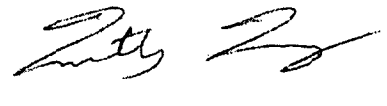
National Aeronautics and Space
Administration of the United States of America

For the European Space Agency


MICHAEL D. GRIFFIN
ADMINISTRATOR


JEAN-JACQUES DORDAIN
DIRECTOR GENERAL

I certify this to be a
true copy of the signed
NASA-ESA-ESA Pathfinder
MOU.


Timothy Tawney